Forest Insect & Disease Management

Evaluation Report

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OAK MORTALITY ON THE HURON-MANISTEE NATIONAL FOREST

St. Paul Field Office

INTRODUCTION

In 1966 thousands of oaks in mid-lower Michigan died. The tops of many others were killed. Eventually these trees died and, by 1969, most oaks in several 100-acre stands were dead. In stands that fared better, scattered individual oaks died 1966-74, and still others were declining in 1974. Oaks on probably 100,000 acres were affected to some degree, most extensively on the sandy flats in the Baldwin-Wellston area.

Most of the oaks killed were in the red oak group, Quercus ellipsoidalis, Q. velutina, and Q. rubra. Millers (1967) ascribed the mortality to defoliation by frosts, leafrollers, and grasshoppers followed by sap borer (Agrilus) attack and drought. Staley (1965) and Nichols (1968) have shown that two years of defoliation early in the growing season can kill oaks outright, or so weaken them that they are killed by normally minor pests--notably the two-lined chestnut borer (Agrilus bilineatus).

Oak Mortality Area

A further evaluation of the problem was requested by the Huron-Manistee National Forests. The investigation was begun in 1974 by J.T. O'Brien (currently with Portsmouth Field Office). This report is based upon his data.

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OBJECTIVES

1. Compare Michigan temperature records from 1950 to 1970, and determine if unusual late frosts occurred at about the time the trees died.

2. Examine the growth ring patterns of the oaks to determine when the injury occurred, and to correlate growth rates with temperature records.

3. Investigate evidence of other possible causes found in the course of the study.

METHODS

Temperature records for May and June from 1950 to 1970 were obtained from the Weather Service and the Baldwin State Forest or the Luther or Evart Station when possible. Daily high and low temperatures were charted and compared.

To study the growth patterns of the oaks, 30 large trees (8" plus d.b.h.) were felled and sampled. Of these, 14 were dead. Before a dead tree was felled, a smaller, live tree beneath it was cut. The growth ring pattern of the smaller tree was used to determine when the tree above died and the small tree was released. For comparison with the dead trees, nine apparently healthy trees and seven live, but injured trees (with one or more of the large limbs dead) were cut. Random selection of sample trees were based on safety of felling crew and (for dead trees) the association of a small tree.

A 2-inch thick cross section was cut from the top of the stump and marked for identification. In the laboratory, annual growth from 1950 to 1973 for each cross section was measured and plotted on a graph for subjective comparison. Tree age was determined from growth rings. Potential disease material from the crowns of live trees was retained for laboratory culturing.

RESULTS

Weather Records: The temperature charts show late spring frosts are common in the lower Michigan area. On June 22, 1963, the temperature dropped to 31°. Late spring frosts are common after May 25.

Tree Growth Ring Patterns: The rings of the rotten trees were sometimes difficult to discern. Also, some trees displayed a puzzling pattern of growth just before they died. What looks like early wood (large pores) with no accompanying late wood was laid down, apparently for several years. No growth rings were discernible; the number of years' growth involved could only be guessed.

It is suspected that these trees were severely injured, and lived several years using the foliage of epicormic branches for photosynthesis. The suppressed trees beneath them were released at the time of injury, rather than at the time of death.

Trees felled on the sandy flats (lower site index) ranged from 44 to over 100 years. The range of ages of the live trees was similar to that of the dead trees.

Dead Trees: One tree died in 1970, 1 in 1972 or 1973, the other 12 in 1966 or 1967. The growth of 13 trees was low or declining in the last few years before death. However, the gradual decline of the growth of tree numbers 1, 4, and 6--all from the same stand--was almost certainly due to crown closure. In general, growth decrease was abrupt, beginning in 1965 or 1966.

Injured Trees: The growth of 3 of the 7 trees was not distinguishable from that of healthy trees (below). The other 4 had a 5-year period of low growth after 1966. Of these, 1 declined even further; 2 increased growth only slightly; the growth of 1 remained low but stable.

Healthy Trees: A sharp decline in the growth of 3 of the 8 trees occurred in 1962 or 1963. The decrease is reflected in 1 of the injured trees, but in none of the dead trees. The growth of 4 increased after 1965 or 1966, probably because nearby trees died and competition was reduced.

Released Trees: The time of release--7 or 8 years before 1974--was consistent. The growth response of most of the understory trees to release was usually moderate the first year, but vigorous thereafter.

Other Factors: Scars of old insect injuries were common on the twigs of felled live trees, but the insects that made them were not found. Grasshoppers that feed on oak leaves were found in only one area--and there was little tree mortality there. One fungus, tentatively identified as Botryodiplodia, sp. was found on dead twigs of several trees.

DISCUSSION

Frosts: Correlations between the oak mortality and frosts are suggestive only. A widespread killing frost did occur in Lower Michigan on May 28, 1966. Photographs of Michigan oaks taken May 29 show the leaves of many oaks wilted in the manner typical of frost injury. Similar frosts occurred in the springs of 1964 and 1965, according to the temperature charts.

Previous oak decline occurred in Roscommon and Oscoda counties in 1958-1959.

Baldwin State Forest records show 16°F on May 10, 1966--the coldest day in May in the 1950-1970 period; but the leaves of trees photographed May 29 are well expanded. Possibly the leaves photographed are a second set, the May 10 frost having killed the first set. When the frosts of 1964 and 1965 are added, as many as four sets of leaves could have been killed. Such foliage losses from frosts would seriously deplete the starch reserves of the trees.

Insects: Millers states no defoliation of Michigan oaks occurred in 1965. Insect defoliation then was probably not involved in the 1966 mortality. Sap borers, such as the two lined chestnut borer, could have built up sufficient populations on trees weakened by frosts to have caused the widespread mortality. As Millers states, the insect populations could have had restraints that operated in previous years, but not in 1966. This theory would be difficult to test.

Site: Nearly all of the dead oaks are on the sandy flats (site index 55 or less) which are a common, if not dominant, feature of mid-Lower Michigan. Few oaks on other, better, sites died. During droughty climatic periods, soil moisture in the sandy flats would be low. Trees on such sites are unlikely to recover readily from injury or stress of any sort. Site does seem to be important in the oak mortality.

Fungi: Many attempts have been made to isolate the oak wilt fungus, Ceratocystis fagacearum, from the dead or dying oak in areas with extensive mortality. All have failed. The fungus found in the course of this investigation, identified as Botryodiplodia, has been reported as a twig pathogen of chestnut oak (Q. prinus) in Pennsylvania. The probability that this fungus alone could cause the extensive injury reported here is remote. It is very unlikely that any fungus could kill so many trees over so large an area in so short a time.

Host Species: Black oak and the northern pin oak on the Manistee National Forest are on the edge of the host range. It is common for species on the edge of the range to experience problems with drought, frost, and a variety of other stress factors.

CONCLUSIONS The 1966 mortality was probably caused on poor sites by sap borers after the trees were predisposed by frost, drought, defoliation, twig borers and twig pathogens. The continuation of the mortality is associated with the same predisposing factors which have occurred with less severity since 1966.

LITERATURE CITATIONS

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